Introduction to Technical Drawing & Design - UAS

Level: 2
Career Cluster: Advanced Manufacturing
Program: Engineering
Pathway(s): Engineering Applications UAS, Aerospace Engineering Technician, Engineering

Course Catalog Description

Introduces technical drawing, engineering design, and drone/UAS applications through sketching, dimensioning, projection, and CAD. Students explore engineering and unmanned aircraft careers while creating and communicating design solutions for drone components, systems, and related technologies.

Summary

This course introduces students to the foundational skills and concepts of technical drawing, engineering design, and drone/UAS systems. Students explore career pathways and postsecondary opportunities related to engineering, aerospace, and unmanned aircraft technology while developing professionalism, ethical awareness, and an understanding of industry expectations. Through a combination of freehand sketching, geometric construction, measurement, scale, dimensioning, and multiview and pictorial drawing, students learn how technical drawings communicate ideas with precision and clarity. The course emphasizes the use of traditional drafting tools and computer-aided design (CAD) software to create, revise, and present technical drawings for products and drone-related components such as frames, mounts, housings, and payload supports. As students apply the engineering design process to solve problems, they also examine drone safety, regulations, and practical design constraints, building the ability to document, evaluate, and communicate technical solutions through professional documentation and a comprehensive capstone project.

Notes

This revised document keeps the core focus on drafting and design fundamentals but presents the content in a clearer, more standards-aligned format. The earlier course emphasized broad drafting and CAD-CAM applications, while this version includes a stronger catalog description, summary, and explicit student learning outcomes organized by topic. It also more intentionally embeds professionalism, postsecondary planning, leadership, work-based learning, and academic standards alignment throughout the course. Major updates include a stronger connection to engineering applications, aerospace engineering technician preparation, and drone/UAS-related design work, giving the course a more current industry focus. Expanded content now emphasizes technical sketching, multiview and pictorial drawing, advanced views, CAD fundamentals, the engineering design process, and technical documentation. The course also adds dedicated leadership and work-based learning sections, an academic standards crosswalk, and a free resource links section to support implementation.

Student Learning Outcomes

1. Career Exploration and Postsecondary Opportunities

Objective: *Students will analyze career pathways in engineering and drones by exploring industry roles, workplace expectations, required education, certifications, professional organizations, and postsecondary opportunities available in Colorado in order to make informed academic and career decisions.*

1) Identify employment opportunities in various fields with a focus in the area of engineering and drones
    a. Recognize the work typically performed, tools and technology used, and nature of work environments
    b. Identify potential certifications within the careers
    c. Find membership organizations associated with the careers
    d. Understand the necessary education associated within the careers
2) Define professionalism within the context of engineering and drones
    a. Criticism and evaluation
    b. Presentation
    c. Assessment
3) Recognize laws, regulations, and ethics significant to the fields of engineering and drones
4) Identify postsecondary opportunities offered in the state of Colorado
    a. Technical college, community college, 4-year institutions
    b. Certificates, associates, bachelor, and advanced degree opportunities

2. Foundations of Technical Drawing and Engineering Design

Objective: *Students will understand and analyze the purpose of technical drawing and its role in engineering communication, including applications in drone and UAS design.*

5) Define technical drawing and its role in engineering and drone/UAS design.
6) Describe how drawings communicate ideas in engineering, manufacturing, and drone systems fields.
7) Explain differences between artistic and technical drawings.
8) Analyze the importance of precision and clarity in drawings.
9) Evaluate how drawings support manufacturing and construction processes.

3. Drawing Tools, Equipment, and Digital Technologies

Objective: *Students will identify and apply traditional and digital tools used in technical drawing, including technologies used to design and document drone/UAS components.*

10) Identify tools used in manual drafting, digital design, and drone/UAS documentation.
11) Demonstrate proper use of drawing tools and equipment.
12) Explain the function of CAD software in modern design, prototyping, and drone component development.
13) Apply digital tools to create basic drawings of products or drone-related parts.
14) Compare manual drafting and computer-aided design processes.

4. Technical Sketching and Visualization

Objective: *Students will develop spatial reasoning and create freehand sketches to represent engineering ideas, including drone frames, payload layouts, and system concepts.*

15) Sketch objects and drone/UAS components using freehand drawing techniques.
16) Represent 3D objects in 2D formats.
17) Analyze spatial relationships between objects and system parts.
18) Apply visualization skills to interpret product and drone designs.
19) Evaluate sketches for accuracy and clarity.

5. Lines, Lettering, and Drawing Standards

Objective: *Students will apply standard conventions to produce accurate and professional drawings.*

20) Identify different line types and their meanings.
21) Apply correct line weights and styles in drawings.
22) Create technical lettering using accepted standards.
23) Interpret drawing standards used in engineering.
24) Evaluate drawings for adherence to conventions.

6. Measurement, Scale, and Dimensioning

Objective: *Students will apply measurement and dimensioning techniques to communicate design specifications.*

25) Measure objects using standard tools and systems.
26) Apply scale in technical drawings.
27) Dimension drawings accurately using industry standards.
28) Interpret dimensions from existing drawings.
29) Evaluate drawing accuracy based on measurement and scale.

7. Geometric Construction and Design Principles

Objective: *Students will construct geometric shapes and apply design principles to technical drawings.*

30) Construct basic geometric shapes using drafting tools.
31) Apply geometric construction techniques to designs.
32) Analyze design problems using geometric reasoning.
33) Create designs using geometric principles.
34) Evaluate geometric constructions for precision and accuracy.

8. Orthographic and Multiview Projection

Objective: *Students will create and interpret multiview drawings to accurately represent objects.*

35) Explain orthographic projection concepts.
36) Create multiview drawings of objects.
37) Interpret orthographic drawings to visualize objects.

38) Analyze relationships between multiple views.
39) Evaluate accuracy and completeness of multiview drawings.

9. Pictorial Drawings and 3D Representation

Objective: *Students will create pictorial drawings to represent three-dimensional objects clearly.*

40) Identify types of pictorial drawings such as isometric and perspective.
41) Create isometric drawings of objects.
42) Apply perspective techniques to represent depth.
43) Analyze differences between pictorial and orthographic drawings.
44) Evaluate drawings based on clarity and realism.

10. Sectional, Auxiliary, and Advanced Views

Objective: *Students will analyze and create advanced drawing views to represent complex objects.*

45) Explain the purpose of sectional views.
46) Create sectional drawings to reveal internal features.
47) Analyze auxiliary views for inclined surfaces.
48) Interpret complex drawings using advanced views.
49) Evaluate effectiveness of drawings in representing hidden features.

11. Computer-Aided Design Fundamentals

Objective: *Students will apply CAD software tools to develop technical drawings.*

50) Navigate CAD software interfaces.
51) Create 2D digital drawings using CAD tools.
52) Modify designs using digital editing tools.
53) Analyze design efficiency using digital tools.
54) Evaluate CAD models for accuracy and usability.

12. Design Process and Problem Solving

Objective: *Students will apply the engineering design process to develop solutions using technical drawing, including solutions for drone/UAS design challenges.*

55) Identify design problems requiring technical solutions, including problems related to drone structures, payloads, or operations.
56) Apply steps of the engineering design process.
57) Develop solutions through iterative sketching and drawing.
58) Analyze constraints and criteria in design challenges, including safety, weight, balance, and usability.
59) Evaluate solutions based on performance and feasibility.

13. Technical Documentation and Communication

Objective: *Students will produce and present technical documentation that communicates design solutions.*

60) Create technical drawings with complete annotations.
61) Document design processes and revisions.
62) Organize drawings into professional formats.
63) Present technical drawings to an audience.
64) Evaluate documentation for clarity and effectiveness.

14. Technical Drawing and Design Project

Objective: *Students will synthesize drawing and design skills to complete a comprehensive engineering or drone/UAS technical design project.*

65) Design a complete technical drawing project.
66) Apply manual and CAD techniques to create solutions.
67) Construct detailed multi-view and pictorial drawings for an engineering product or drone/UAS concept.
68) Evaluate project accuracy based on criteria and standards.
69) Present and defend final designs.
70) Reflect on design decisions and learning growth.

15. Leadership

Objective: *Students will develop leadership skills by demonstrating responsibility, ethical decision-making, communication, collaboration, and initiative in classroom, project, and career and technical student organization contexts.*

71) Demonstrate leadership behaviors such as responsibility, initiative, dependability, and ethical conduct in classroom and project settings.
72) Apply effective communication, teamwork, and conflict resolution skills when working with peers, instructors, and community partners.
73) Participate in leadership development activities, including career and technical student organization experiences, service opportunities, or collaborative team roles.
74) Analyze how leadership styles, decision-making, and professionalism influence team performance and project outcomes.
75) Evaluate personal leadership strengths and areas for growth through reflection, feedback, and goal setting.

16. Work-Based Learning

Objective: *Students will connect classroom learning to workplace expectations through work-based learning experiences, career preparation activities, and reflection on employability skills, technical skills, and career goals.*

76) Identify the purpose and types of work-based learning experiences, such as industry-sponsored projects, job shadows, mentorships, internships, and workplace tours.
77) Demonstrate employability skills including punctuality, communication, teamwork, problem solving, adaptability, and professional behavior in authentic workplace settings.
78) Apply technical and career readiness skills during classroom-based or community-connected work-based learning experiences related to engineering, drafting, or drone/UAS fields.

79) Document and reflect on work-based learning experiences to evaluate skill development, workplace expectations, and alignment with career goals.
80) Analyze how work-based learning experiences support postsecondary planning, credential attainment, and career pathway decision-making.

17. Career and Technical Student Organizations

Objective: *Using the CTSO Resource Document, chapter activities will provide some of the best opportunities CTSO members will have to learn by doing. A successful program of work creates a positive learning atmosphere in the classroom. CTSO members learn how to accept responsibility, work as a team, manage a budget, and handle success and failure. Per the CTE Admin Handbook, CTSOs are embedded into curriculum.*

Professional Development

Prepare each member for entry into the workforce and provide a foundation for success in a career. Becoming a professional does not stop with acquiring a skill, but involves an increased awareness of the meaning of good citizenship and the importance of labor and management in the world of work.

Community Service

Promote and improve goodwill and understanding among all segments of the community through services donated by CTSO chapters, and to instill in its members a lifetime commitment to community service.

Business and Industry Connections

Increase awareness of quality job practices and attitudes, and increase the opportunities for employer engagement and eventual employment.

Financial Leadership

Plan and participate in activities to allow all members to carry out the chapter's projects. Educate members on their own personal finance for current and future success.

Public Relations

Make the general public aware of the good work that students in career and technical education are doing to better themselves and their community, state, nation, and world.

Social Activities

To increase cooperation in the school and community through activities that allow CTSO members to get to know each other in something other than a business or classroom setting.

Academic Standards Alignment

Colorado CTE courses are required to integrate academic and essential skills into course content. The following academic standards have been identified as aligned to this course and should be integrated throughout instruction.

CO CTE Academic Standards Resources (Rubrics, integration strategies, etc)
CDE Colorado Academic Standards Online (Online standards lookup tool)

Note: Mathematics and Science standards will be added in the future. Visit the Colorado Academic Standards page for the most current version.

Reading, Writing and Communicating Crosswalk

Course: Introduction to Technical Drawing and Design
Colorado Academic Standards – Reading, Writing, and Communicating

Standard	Prepared Graduate Competency	Description	Course Evidence / Alignment
Standard 1: Oral Expression and Listening	Prepared Graduate 1 – Collaboration	Collaborate effectively as group members or leaders.	Students work in design and drafting teams, engage in peer critique, and collaborate on technical problem-solving for product and drone/UAS design scenarios.
Standard 1: Oral Expression and Listening	Prepared Graduate 2 – Oral Presentations	Deliver effective oral presentations for varied audiences.	Students explain drawings and design decisions and present technical solutions and processes to classmates and instructors.
Standard 2: Reading for All Purposes	Prepared Graduate 4 – Informational Texts	Read a wide range of informational texts.	Students read and interpret technical drawings, specifications, drafting standards, symbols, instructions, and selected drone/UAS documentation.

Standard 2: Reading for All Purposes	Prepared Graduate 5 – Language in Context	Understand how language functions in different contexts.	Students use discipline-specific drafting and design vocabulary and professional technical language in written and oral contexts.
Standard 3: Writing and Composition	Prepared Graduate 7 – Informational Writing	Craft informational/explanatory texts.	Students produce technical explanations, drafting documentation, and written descriptions of engineering and drone/UAS design processes.
Standard 3: Writing and Composition	Prepared Graduate 9 – Writing Process	Demonstrate mastery of their own writing process.	The course requires drafting, revising, and finalizing technical work, including polished drawings and written explanations.
Standard 4: Research Inquiry and Design	Prepared Graduate 10 – Research and Ethics	Gather information from a variety of sources.	Students use reference materials and standards and apply researched conventions and requirements to technical drawings.

Free Resource Links

1. Career Exploration and Postsecondary Opportunities

- O NET Online (engineering drone UAS careers job descriptions skills) https://www.onetonline.org/
- CareerOneStop (career exploration training pathways aviation technology) https://www.careeronestop.org/
- FAA Educational Users (drone education pathways safety rules schools) https://www.faa.gov/uas/educational_users
- AUVSI (uncrewed systems careers industry education) https://www.auvsi.org/

2. Foundations of Technical Drawing and Engineering Design

- Engineering Explained (engineering basics design thinking) https://www.engineeringexplained.com/
- Teach Engineering (engineering lessons design fundamentals) https://www.teachengineering.org/
- MIT OpenCourseWare Engineering (engineering fundamentals design concepts) https://ocw.mit.edu/

3. Drawing Tools, Equipment, and Digital Technologies

- Autodesk Learning (CAD modeling design projects tutorials) https://www.autodesk.com/learn
- Autodesk Project Design a Model for 3D Printing (micro drone chassis CAD project) https://www.autodesk.com/learn/ondemand/module/project-design-a-model-for-3d-printing
- Tinkercad (3D modeling beginner CAD tools prototypes) https://www.tinkercad.com/
- DroneBlocks (drone coding classroom STEM resources) https://droneblocks.io/

4. Technical Sketching and Visualization

- Drawabox (drawing fundamentals perspective structure) https://drawabox.com/
- Line of Action (sketching practice gesture drawing) https://line-of-action.com/
- RapidFireArt (sketching shading techniques) https://rapidfireart.com/

5. Lines, Lettering, and Drawing Standards

- Engineering Toolbox (engineering standards conventions symbols) https://www.engineeringtoolbox.com/
- GD T Basics (dimensioning standards tolerancing) https://www.gdandtbasics.com/

- ANSI Standards Overview (drafting standards guidelines)
  https://www.ansi.org/

6. Measurement, Scale, and Dimensioning

- Math is Fun Measurement (measurement units scale concepts)
  https://www.mathsisfun.com/measurement/
- Khan Academy Geometry (measurement scale geometry)
  https://www.khanacademy.org/math/geometry
- NIST Measurement Resources (measurement accuracy standards)
  https://www.nist.gov/

7. Geometric Construction and Design Principles

- Math Open Reference (geometry constructions tools)
  https://www.mathopenref.com/
- GeoGebra (geometry construction visualization tools)
  https://www.geogebra.org/
- CK 12 Geometry (geometry lessons construction principles)
  https://www.ck12.org/

8. Orthographic and Multiview Projection

- Engineering Design Graphics Tutorials (orthographic projection drawing)
  https://edgincsites.com/
- MIT Visualization Resources (multiview visualization concepts)
  https://web.mit.edu/
- YouTube Learn Engineering (projection technical visualization)
  https://www.youtube.com/@LearnEngineering

9. Pictorial Drawings and 3D Representation

- SketchUp Campus (3D modeling pictorial drawing)
  https://learn.sketchup.com/
- Blender (3D modeling rendering basics)
  https://www.blender.org/
- Tinkercad Lessons (3D design modeling basics)
  https://www.tinkercad.com/learn

10. Sectional, Auxiliary, and Advanced Views

- GD T Basics Section Views (section drawings auxiliary views)
  https://www.gdandtbasics.com/section-views/
- Engineering Explained Drawing Views (advanced drawing concepts)
  https://www.engineeringexplained.com/
- Autodesk Tutorials (CAD sectioning advanced tools)
  https://academy.autodesk.com/

11. Computer-Aided Design Fundamentals

- Fusion 360 for Students (CAD design modeling tools)
  https://www.autodesk.com/education/edu-software/fusion-360
- FreeCAD (CAD modeling design software)
  https://www.freecad.org/
- Onshape Learning Center (CAD cloud based modeling)
  https://learn.onshape.com/
- SolidProf Tutorials (CAD tutorials workflows)
  https://solidprof.com/

12. Design Process and Problem Solving

- NASA Aeronautics STEM (engineering design advanced air mobility drones)
  https://www.nasa.gov/aeronautics/aeronautics-stem/
- FAA UAS (drone safety regulations airspace operations)
  https://www.faa.gov/uas
- Teach Engineering Design Process (engineering problem solving steps)
  https://www.teachengineering.org/
- DroneBlocks (autonomous drones coding design challenges)
  https://droneblocks.io/

13. Technical Documentation and Communication

- Purdue OWL Technical Writing (technical communication writing skills)
  https://owl.purdue.edu/
- Microsoft Learn Documentation Basics (technical documentation skills)
  https://learn.microsoft.com/
- Google Technical Writing Courses (documentation communication skills)
  https://developers.google.com/tech-writing

14. Technical Drawing and Design Project

- Instructables Engineering Projects (design projects prototyping)
  https://www.instructables.com/
- Maker Education Initiative (project based learning design)
  https://makered.org/
- Autodesk Student Gallery (student design portfolio examples)
  https://www.autodesk.com/education
- Engineering.com Projects (engineering design case studies)
  https://www.engineering.com/

15. Leadership

- National Coordinating Council for Career and Technical Student Organizations (CTSO leadership career readiness student organizations)
  https://www.ctsos.org/
- SkillsUSA Programs (leadership development workplace skills chapter activities)
  https://www.skillsusa.org/programs/

- Lead4Change High School (student leadership teamwork service learning) https://lead4change.org/high-school/
- SkillsBuild Career Readiness Teacher Toolkit (communication resume interview leadership skills) https://skillsbuild.org/career-readiness-teacher-toolkit.pdf

16. Work-Based Learning

- Colorado CTE (Colorado work-based learning toolkit program quality resources) https://cteincolorado.org/
- SkillsUSA Work-Based Learning (career discovery mentoring workplace readiness) https://www.skillsusa.org/students/work-based-learning/
- Youth.gov Career Exploration and Skill Development (mentoring internships job shadowing employability) https://youth.gov/youth-topics/youth-employment/career-exploration-and-skill-development
- CareerOneStop Outreach Materials (career exploration job search workplace preparation handouts) https://www.careeronestop.org/Outreach/outreach-materials.aspx

Technology Student Association – National Competitive Events

Transportation Modeling

Objective: *Students will research, design, produce, document, and present a scale model vehicle that responds to the annual TSA Transportation Modeling design problem.*

- Research current and past vehicle designs related to the annual transportation modeling challenge.
- Develop concept drawings, detailed sketches, or 3D CAD models that communicate the vehicle design.
- Create accurate technical illustrations and orthographic plans that include necessary details and dimensions.
- Produce an original scale model using approved materials and production methods.
- Design a display that professionally presents the model and supports the design concept.
- Compile a documentation portfolio that includes research, scale information, sketches, production photos, and final technical illustrations.
- Participate in an interview explaining the research, production process, design decisions, and final model.

Resources

- Technology Student Association – Transportation Modeling competition guidelines https://tsaweb.org/competitions-programs/tsa/themes-problems
- Autodesk Fusion – CAD/CAM modeling and manufacturing tools https://www.autodesk.com/products/fusion-360/education
- Onshape Education – Browser-based CAD and 3D modeling https://www.onshape.com/en/education/
- Xometry – Manufacturing process resources https://www.xometry.com/resources/

Technology Student Association – National Competitive Events

Dragster Design

Objective: *Students will design, draw, build, test, and present a CO2-powered dragster that meets TSA specifications for performance, construction quality, technical drawing, and dimensional accuracy.*

- Design a CO2-powered dragster that follows the annual TSA specifications and design requirements.
- Create a full-size metric technical drawing showing top and side views of the complete vehicle.
- Apply standard engineering practices, dimensions, and drawing conventions to communicate the vehicle design.
- Build the dragster from approved materials using safe production methods, which may include hand tools, power tools, CNC milling, or 3D printing.
- Prepare a materials list documenting all parts and materials used in the dragster.
- Test the vehicle through qualifying race procedures and evaluate performance, safety, and specification compliance.
- Complete a short interview explaining the design, construction process, production decisions, and performance results.

Resources

- Technology Student Association – Dragster Design competition guidelines https://tsaweb.org/competitions-programs/tsa/themes-problems
- Autodesk Fusion – CAD/CAM tools for product design and fabrication https://www.autodesk.com/products/fusion-360/education
- CO2 Dragster Design Resources – Pitsco Education https://www.pitsco.com/
- Onshape Education – CAD tools for technical drawings and parts modeling https://www.onshape.com/en/education/

Technology Student Association – National Competitive Events

Structural Design and Engineering

Objective: *Students will design, document, fabricate, and test a structural model that meets TSA Structural Design and Engineering requirements for technical drawing, construction quality, safety, and load performance.*

- Design a structure that responds to the annual TSA structural challenge and follows required specifications.
- Create a full-size, three-view drawing of the structure using hand drafting or computer-generated drawing methods.
- Document the structure through a required portfolio that includes the event title, team verification, and technical drawing components.
- Construct a pre-built structure prior to competition check-in for preliminary evaluation.
- Use approved tools, measuring devices, adhesives, cutting surfaces, and safety eyewear during the on-site semifinal build.
- Fabricate an on-site structure using TSA-provided construction materials and required planning supplies.
- Evaluate structural performance through measurement, weight, testing results, design quality, and failure analysis.

Resources

- Technology Student Association – Structural Design and Engineering competition guidelines
  https://tsaweb.org/competitions-programs/tsa/themes-problems
- TeachEngineering – Structural engineering design activities
  https://www.teachengineering.org/
- West Point Bridge Designer / Bridge design learning resources
  https://bridgecontest.org/
- Autodesk Education – CAD and modeling software
  https://www.autodesk.com/education/edu-software/overview